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FOREIGN HONORARY MEMBERS.

HEINRICH WILHELM DOVE.*

HEINRICH WILHELM DOVE, who has been a foreign honorary member of this Academy since Nov. 14, 1859, was born in Liegnitz, Silesia, on the 6th of October, 1803, and died in Berlin on the 4th of April, 1879. He was the youngest child of a prosperous merchant who had been twice married. Of this large family, only two, own sisters of Heinrich, lived to an advanced age. While young Dove was still in his childhood, his father suffered serious reverses from the depression of business and the crushing taxes produced by the wars of Napoleon the First. His mother, left a widow in 1810, continued the business of his father, and made great exertions and sacrifices in order to give a good education to her children. Dove was diligent and successful in his studies, and at the age of twelve he was sent to the Ritter Academy. Here he so distinguished himself, especially in mathematics, as to be called by his companions the Little Professor. At the age of seventeen he was prepared for the University. Cradled in one of the stormiest periods of European history, Dove had passed his childhood and youth within sight or sound of stirring events, the memory of which never faded from his mind. The years 1813–15 particularly, and the retreat of Jahn after the battle of Katzbach, produced a profound impression upon him. In later life he indulged in reminiscences of his youth: telling the story of his being compelled to eat before the French grenadiers, because they were afraid of being poisoned.

At Easter of the year 1821, Dove entered the University of Breslau, where he passed six semesters, devoting himself at first to philological studies. But he soon came under the influence of Brandes, the Professor of Mathematics at Breslau from 1811 to 1826. His lectures on mathematics, astronomy, physics, and meteorology attracted many students by their substance and the happy manner of its presentation. When Dove entered the University, Brandes had just published his *Beiträge zur Witterungskunde*, and had recommended meteorological observations. While students at Göttingen, Brandes and Benzenberg had determined, by parallax, the distances and velocities of shooting-stars and meteors; and had assigned them their true place in the Cosmos, outside the earth's atmosphere. Under this new inspiration, Dove abandoned his first love, and courted the natural sciences, especially physics and mathematics. But he was not destined to complete his studies at Breslau. Academical life at this time was full of excitement. In 1815 the national alliance of German students (*Burschenschaft*) was formed: the Wartburgfest of 1817 had given many an opportunity to join this association. Although it was forbidden in 1819, after the murder of Kotzebue, the fellowship continued. At the Jubilee of Dove's doctorate, in 1876, Dr. Falk said that his father and Dove were not only classmates (*Primaner*), but fellow-members of the Burschenschaft; and that, while his father had the taste of the inside of a fortress, Dove came off with exile.

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* The death of Dove, although reported last year, took place so near the time of the Annual Meeting that this notice was necessarily deferred until the present Report.

Dove went to Berlin, to continue his studies. There he gave his time to physics, and was in intimate friendly relations with the eminent interpreter of that subject, Paul Erman. He also studied diligently Hegel's philosophy, including his natural philosophy; but he did not conceal the fact that he was not a convert to the Hegelian philosophy. He graduated on March 4, 1826, and in his dissertation for the Doctor's degree, *De Barometri Mutationibus*, he first blossomed out as a meteorologist, and foreshadowed the career in which he was to achieve his greatest distinction.

Dove was now twenty-two years old. The death of his mother had left him wholly to his own resources, since none of his brothers could aid him in the intellectual objects of his ambition. He left Berlin and took up his residence in Königsberg for the study and teaching of the physical sciences. At first he was a *Privat-docent*, and for two years Professor Extraordinary. In the first semester of 1826–27, he instructed publicly in thermics, and privately on the general principles of physics and experimental optics. Dove was young for a teacher; and his small, elastic, compact figure made him appear younger than he was. At the Jubilee celebration of 1876, to which allusion has already been made, Helmholtz described the subdued delight with which Dove was reading his first announcement on the blackboard of the University, when one of the older students clapped him on the shoulder, and said: "Well, little fellow (*Füchslein*), have you selected the lectures which you wish to hear?" "Yes," he replied, "I shall hear Dove." The older student answered, "That is right good: you will enjoy all his wisdom to yourself."

At Königsberg, Dove's intellectual life was greatly stimulated in the circle of professors to which he was freely admitted. Bessel's active and brilliant mind fascinated him. At Bessel's house, he met the cousin of his future wife, Adolph Erman (afterwards Bessel's son-in-law), and a friendship was formed which ripened into intimacy when both were afterwards in Berlin. Jacobi, soon to become illustrious as a mathematician, had resided in Königsberg since 1824, and was nearly of the same age as Dove. F. E. Neumann, destined to the place of Professor of Optical Mineralogy, was a *Privat-docent* in 1826. Moser, the future Professor of Physics, and the associate editor with Dove of the first four volumes of the *Repertorium der Physik*, was also a member of this sympathetic group of scientific worthies. Notwithstanding all these congenial surroundings, Dove's heart turned fondly to Berlin, and in 1828 he visited that city to attend the gathering of scientific men under the auspices of Humboldt. Dove's talents were recognized by Humboldt, and a friendship began there and then, which ended only with the life of Humboldt. Dove co-operated with Humboldt in the term-day observations of the magnetic elements for the earth, and he was the first of many others, united in the same work, to publish his observations. The year 1828 was the turning point in Dove's destiny. Then was formed the engagement to the lady whom he married in 1830 at Berlin. Although he had been accustomed from his youth to a simple style of living, a change of residence was soon rendered necessary by the requirements of his family, and, in spite of the remonstrances of the minister Altenstein, he removed to Berlin.

Dove began his new labors by teaching physics and mathematics in the Gymnasium, in a girls' high school, and in the Institute of Technology. In 1841, he succeeded Paul Erman in the Military School and in the School of Artillery. He was soon made Extraordinary Professor of Physics in the University; and, finally, in 1845, Ordinary Professor. But his salary was never large; and he continued his instruction in the Institute of Technology until he was sixty years old, and in the Military School until the year 1877, after paralysis had warned him of his increasing infirmities. The latter position was valuable to him, as it secured for him a residence in the third story of the War Building, where he lived for many years, and where he died.

For half a century, Dove was a hard-working and painstaking teacher. During many of these years he taught general physics in the Gymnasium for eight or twelve hours a week, and to all the classes. Mathematics required of him an equal amount of time. His instruction in the Schools of War and Technology, and in the University, was given by lectures on physics and meteorology. For the experimental illustration of these lectures he spared no time or labor. He was a familiar sight in the streets of Berlin, as he carried such apparatus as belonged to him from his house, or from one audience to another, in his hand or in a market-basket. But familiarity only deepened the universal respect which his presence always inspired. For a hundred semesters there sat at his feet a succession of interested students, many of whom afterwards, by their own fame, magnified his renown. In the city which had hung with delight upon the lips of Humboldt in 1827–28, the seats and aisles of the largest auditorium were crowded by all ranks of society, to listen to Dove's lectures on meteorology. Germany could not boast of a more clear and eloquent expounder of science, or of a teacher gifted with greater power of infusing his own scientific spirit into those who heard him. Dove was indeed the Faraday and Arago of the scientific and fashionable circles of Berlin.

This learned, laborious, and successful teacher was none the less an original investigator. Two hundred and thirty-six contributions to science between the years 1827 and 1876, published principally in the *Abhandlungen* or the *Monatsberichte* of the Berlin Academy, or in the *Zeitschrift* of the Prussian Statistical Bureau, bear witness to the fertility and originality of his mind. He has left his impress on all the physical sciences, — on electricity and magnetism, on the metric system, acoustics, optics, and optical crystallography. Coronæ, subjective colors, binocular vision, and binaural hearing interested him greatly; and whatever he touched he enriched, not only by his original ideas, but by new instruments of his own happy invention. A differential inductor, a polyphonic siren, a variety of new stereoscopes, a pseudoscope, a photometer, a stephanoscope, his rotating disks for optical deceptions, his complete polarizing apparatus, his rotating polarizer, his new polarizer of Iceland spar, his new analyzer of arragonite, his prisms to produce circular polarization in place of Fresnel's rhombs, his adaptation of the kaleidoscope to the chromatic effects of polarized light, all these ingenious instruments and appliances have made the name of Dove a household word in every well-equipped physical cabinet on both continents. His application of the stereoscope to distinguish a bank-note from its counterfeit, and thereby to detect forgery, is used in many of the banks and offices of Germany.

But it is a greater work to create a new science, especially if it intimately concerns the comfort and safety of mankind, than to extend and illustrate old ones. What, then, are Dove's claims to be called, as he has been in and beyond Germany, the Father of Meteorology? What passed for meteorology, even within the memory of living men, let the most popular almanacs proclaim. An attempt was made in the last century (almost abortive because it was short-lived) to lay a safe foundation for meteorology by introducing into it the precision and co-operation which had led to such happy results in astronomy; a precision and a co-operation the more imperative and at the same time the more difficult, as the physics of the Globe are more complex than those of the Cosmos. The meteorological society of the Palatinate, organized by Prince Charles Theodore of Mannheim, supplied observers in and out of Germany with uniform instruments, and published their observations in the *Mannheimer Ephemeriden* for 1781–94. The next great awakening on this subject came from Humboldt, for whom every aspect under which the physics of the earth could be contemplated had a profound interest. At his word, numerous meteorological observatories sprang up in the vast territories of the English and Russian empires, also in Europe and America, which supplied him with materials for taking a comprehensive glance at the distribution of the earth's temperature. In imitation of Halley's graphical method of displaying the distribution of terrestrial magnetism, Humboldt constructed isothermal curves, which, by their inclination to the parallels, betrayed their dependence on geographical peculiarities, as well as on astronomical agencies. Dove applied the same construction to each month of the year, handling, for this purpose, vast numbers of observations, many of which required reductions and corrections before they were suitable for comparison.

When, in 1844, Dieterici had been placed at the head of the Prussian Statistical Bureau, Humboldt called his attention to the wants of meteorology, to the defects in the methods of observing, to the crude condition in which observations were often left, and to the incompleteness in the network of meteorological stations. In 1846, Dr. Mahlmann was made Director of the Meteorological Institute of Prussia; but he died in 1848, when he had only begun the needed reforms, and Dove was appointed as his successor. Under Dove's administration old observations were computed (those at Berlin extending back to 1719), affiliated posts for observers were judiciously selected and gradually increased from thirty-one to one hundred and fifty-three, and the results given promptly to the scientific public.

Dove had distinctly in mind three aspects under which the conditions of the atmosphere should be studied: 1. The mean values of the elements; 2. Their periodical changes; 3. Their non-periodical changes. He discussed particularly the non-periodical changes of temperature, and published his conclusions at five different times between the years 1838 and 1852 in the *Abhandlungen* of the Berlin Academy. He divided the year into seventy-three periods, each five days in length, and computed the mean temperature of every one of them, — a method which was indorsed by the first international congress of meteorologists in 1873. He exploded the notion that the late frosts between the 11th and 13th of May, from which the orangery of Frederick the Great at Sans Souci did not escape, had any wide significance. Though popular tradition associated them with the death or martyrdom of Mamertus, Pancratius, and Servatius, and assigned to them a cosmical origin, the phenomenon was strictly local, and was explained, where it occurred, by the reflex action of a cold district in the neighborhood.

Brandes first broached, in 1820, his centripetal theory of storms, as the result of his study of the weather of 1783. In 1826, he published what he regarded as a confirmation of his views, deduced from the great storm of December 24, 1821. In 1828, Dove re-examined the data which had led Brandes to his conclusion, and maintained that the latter storm was a true whirlwind, revolving against the motion of the hands of a watch, while the storms of the southern hemisphere, which he had investigated, revolved in the opposite direction. Before Dove resumed the subject, Redfield and Reid on the one hand, and Espy on the other, had been engaged in an animated discussion on the merits of the centrifugal and centripetal theories as exemplified in the storms of the Atlantic, the hurricanes of the West Indies, and the typhoons of the Chinese Sea. Dove generously admits, with a candor not always found in scientific men, that Redfield and Reid had reached their conclusions without the aid or knowledge of his own earlier publications on the subject, and he credits them for their rich materials and their independent generalizations, in his "Law of Storms," published in 1841. He says: "But Redfield and Reid, besides placing on a wider basis the rotary movement, which takes place in opposite senses in the two hemispheres, have added, further, some very important observations, the empirical establishment of which is entirely their own ; these I shall attempt to connect theoretically with the cyclone movement." He then proceeds to show that the larger whirlwinds, and their opposite characters north and south of the equator, may be evolved from Hadley's general theory of the trade-winds and the transfer of air across parallels of different magnitudes; admitting at the same time that lesser whirls of air and water, not obedient to the same law of direction, may originate in the conflict of local and accidental winds.

What Dove has called the "Law of Rotation" of the winds has a more universal, though a less boisterous, applicability to the facts of meteorology than his "Law of Storms." Aristotle appears to have had glimpses of this law, according to which all changes of the wind, not local and transitory, followed each other, not at random, but in a regular order, which is reversed for the southern hemisphere. This law declares, in popular language, that there is no permanent change of weather if the wind backs round. Bacon in 1600, and Sturm in 1676, refer to this rule; farmers and navigators are familiar with it. Bacon says: "Si ventus se mutet conformiter ad motum solis . . . non revertitur plerumque, aut, si hoc facit, fit ad breve tempus." As was said at Dove's Jubilee: "For two thousand years men had witnessed the phenomenon without seizing the significance of it." Dove found the explanation in the incessant struggle between the equatorial and polar currents of the same hemisphere, which alternately push each other up and down and from one meridian to another. His educated ear caught in the whisperings or rustlings of the winds the key-note to all the non-periodical changes of the weather; and he elucidated his views by the discussion of thousands of observations of the barometer, thermometer, and hygrometer, extending over fifty years. If Dove gave a wider extension and a more exclusive jurisdiction to Hadley's theory of the trade-winds than all meteorologists would be ready to admit, if he did not allow sufficient scope to the centripetal theory and to antecedent influences which caused the two antagonistic currents to dislodge one another, nevertheless he succeeded in bringing order out of chaos, and in shedding the light of a principle on a confused mass of heterogeneous observations. Truly has it been said: "By his Herculean but well-directed labor he has written his name in large, imperishable characters on the records of science." Dove first appeared before the world as an author in 1827, with a paper on the Winds. This was followed by eight others, all of them on meteorology, and the largest part of his voluminous writings were on the same subject. His last publication in the *Abhandlungen* of the Berlin Academy, was on the weather of 1875–76, and his contribution to the *Jubelband* of Poggendorff was on the meteorological differences between the northern and southern hemispheres. *Par excellence*, Dove was a meteorologist.

Some of Dove's most valuable contributions to journals or transactions were also published as independent works. His "Gesetz der

Stürme" passed through four editions in Germany, and was translated into English and French. "Klimatologie von Nord Deutschland" appeared in two volumes in 1868–71; the "Klimatologische Beiträge," in two parts, in 1859–67; the "Meteorologische Untersüchungen," in 1837; "Ueber Maass und Messen," two editions, in 1833 and 1835; "Der Kreislauf des Wassers auf der Oberflache des Erde," in 1866, and a translation in 1871; "Eiszeit, Föhn, und Sirocco," in 1867; "Der Schweizerische Föhn," in 1868; "Gedächtnissrede auf von Humboldt," in 1869. Some of his most important works were translated and published in Taylor's Scientific Memoirs, and in a volume of the British Association for 1853. Dove was also the editor or co-editor of eight volumes of "Repertorium der Physik, 1837–45," to which he largely contributed.

In 1838 Dove published "Die neuere Farbenlehre," which reached a second enlarged edition in 1853, with a somewhat different title. In this book he gives an account of his own original observations and instruments. He repeats in the preface to the second edition his comments on Goethe's criticism of Newton's theory of colors: "For the history of science shows that, notwithstanding the confirmation which observation has given to the wave theory, there never will be wanting, in all time, those to whom the Jesuit Castel is a greater authority than Huyghens, Newton, Fresnel, and Frauenhofer."

Dove was happy in his home. Of four sons and as many daughters, one, a lieutenant in the army, died in 1874 of consumption, induced by the fatigues and exposure of war. Two of his sons he saw elevated to the position of Professors at Göttingen and at Breslau. He himself rejoiced in his work, and none the less in society. In the forenoon, when he was not teaching, he was at his house, and accessible to all. In the afternoon he made a short visit to a confectioner's shop, where he read the papers and took a cup of coffee. But travelling was his chief recreation. His knowledge of modern languages made all societies agreeable and instructive. Often he was sent on delegations by the government. In 1830 he visited Warsaw in the time of the cholera. In 1845 he made a tour of France, England, and Scotland. He was one of the judges at the World's Expositions, in 1851 and 1861 at London, and in 1855 and 1867 at Paris. He attended the scientific associations in Germany, and in 1864 in Switzerland. Every year he visited the meteorological stations in Germany, and occasionally those outside of his own jurisdiction.

Dove was the youngest member and the last survivor of a most brilliant circle of literary and scientific men, who made illustrious the first period of the University of Berlin; and as such he received its highest honors. He was chosen its Dean and Rector. The government vied with the University in doing him homage. He was Privy-Councillor, and one of the board of examiners for civil and military service. At court his presence was always welcomed, and no gathering of learned men took place in the palace from which he was missing. He was an officer of the *Legion of Honor*, and at his Jubilee in 1876 he received the star of the *Red Eagle Order*. In 1860 he was made a member of the *Ordre pour le Merite*, and in 1867, by the special favor of his high patron, the King, Vice-Chancellor of the *Friedensclasse* of that Order.

Dove was chosen a member of the Berlin Academy in 1837. He was also an Associate of the Berlin Geographical Society, and contributed to its discussions and publications. After the death of Ritter and Barth, he was the most conspicuous member, and at its forty-fifth anniversary he served as its Honorary President. The name of Dove stands upon the rolls of honor of all the brilliant academies of Europe. His merits were early recognized by this Academy, in 1859, when he was elected a Foreign Honorary Member.

JAMES CLERK MAXWELL.

James Clerk Maxwell, the only son of John Clerk Maxwell, Esq., was born in 1831 at Middlebie in Scotland. His early education was obtained at the Edinburgh Academy, where he was given the academical club medal for geometry in 1845, and the silver medal for mathematics in 1847. After leaving the Edinburgh Academy, Maxwell entered the University of Edinburgh, and was under the instruction of Kelland, Forbes, and Gregory. In October, 1850, he entered at Peterhouse in Cambridge, and in 1854 was made Second Wrangler and bracketed as First Smith's Prize-man. In December, 1850, he left Peterhouse College and entered his name at Trinity, where, in 1855, he became a Fellow. In 1856, he obtained the Professorship of Natural Philosophy in Marischal College, Aberdeen. In 1860, he succeeded Goodeve as Professor of Natural Philosophy and Astronomy in King's College, London. On the death of his father he retired, in 1865, to his estate in Scotland. In 1871, he accepted the chair of Experimental Physics at Cambridge, and was appointed Director of the Cavendish Physical Laboratory, which was built and equipped under his personal supervision. The American Academy of Arts and Sciences of Boston has the honor